

Mariner Venus/Mercury 1973 Mission Support

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During July and August 1973, the DSN continued activities to complete open hardware and software implementation tasks for Mariner Venus/Mercury 1973 (MVM'73). However, the primary activity during this period was DSN testing/training for MVM'73, including DSN system testing, DSN/spacecraft compatibility testing, and DSN support for mission operations system testing.

I. Planning Activities

A. NASA Support Plan

In August 1973, the DSN received NASA Headquarters correspondence directing that the NASA Support Plan (NSP) for MVM'73 be revised and resubmitted for final approval. The revised NSP will be submitted for NASA Headquarters' approval during the next reporting period.

B. DSN Operations Plan

The final, unsigned version of the DSN Operations Plan for MVM'73, which was released in May 1973, proved to

be very satisfactory for use during test activities. Therefore, effort on the approved version was reduced, resulting in an expected September 15, 1973, issue date rather than mid-July as planned.

C. DSN Support Team

Since the active members of the DSN Support Team for MVM'73 are now all from the DSN Operations Organization, it has been decided that the former activity shall terminate. The DSN Manager and Network Operations Project Engineer shall continue to meet as necessary to discuss matters normally handled by the support team.

II. Program Control

A. DSN Operational Readiness Review

The DSN Operational Readiness Review for MVM⁷³ is now scheduled for September 26, 1973. This shall be a detailed presentation of all factors in DSN Engineering and DSN Operations which have a bearing on DSN operational readiness. The agenda includes implementation status, training/test accomplishments and results, DSN/spacecraft compatibility verification results, and Review Board assessment.

B. Network Briefing

During August 1973, the DSN Manager for MVM⁷³ visited Deep Space Stations (DSS) in Australia and Spain. The purpose of this trip was to review DSS preparations for MVM⁷³, to discuss problem areas, and to present MVM⁷³ mission sequence information. Discussions were held with DSS managers and with system engineers of each technical area. This briefing will be conducted in September 1973 for local DSSs.

III. Implementation Activities

A. Ground Communications Facility (GCF) Status

During July 1973, technical problems were encountered in the wideband coded multiplexers during final acceptance tests at the contractor's facility. This caused further delays in accomplishing final wideband capabilities required to support DSN system tests. Shipment was made to all required DSS locations in August 1973, and installation is now essentially complete. DSS internal testing of high-rate telemetry capabilities can now continue. The coded multiplexer power supplies, however, do not meet specifications and are scheduled for replacement in October 1973. Implementation of the 230-kilobits/s wideband circuit between DSS 14 and JPL was completed on schedule, August 1, 1973. It has been used successfully during Project tests for real-time transmission of 117.6-kilobits/s imaging data.

B. DSS Status

There has been a significant improvement in accomplishment of delinquent, minor implementation tasks carried on Engineering Change Orders. Major implementation tasks, except planetary ranging and S/X-band which are committed to be operational at later dates, have been completed. Revision A to the DSS telemetry and command software program nears completion but somewhat later than requested.

1. **Telemetry and command data subsystem (TCD).** The previous article described a potential schedule problem in accomplishing an update to the TCD software program DOI-5050-OP. For test support purposes, it was desired that this update (Revision A) be available on August 15, 1973. However, software development resources and development requirements of other projects precluded this. Negotiations resulted in a planned availability date of September 1, 1973, an improvement over the advertised October 15, 1973, date. Work on the revision continued on schedule until late August, at which time software development resources were fully applied to resolve a command software problem for Pioneer. Therefore, completion of acceptance tests for MVM⁷³ TCD software was delayed about 10 days. To meet Mission Operations System test support requirements beginning September 5, copies of the Revision A program were shipped to all DSSs on August 31, 1973. This version has not been formally transferred and will be used only for test support purposes until receipt of the operational version about September 15, 1973.

2. **Digital instrumentation subsystem (DIS).** The new DIS software program (DOI-5046-OP) received by the DSSs in June 1973 has been integrated and utilized to transmit high-speed monitor and tracking data during tests. Minor format anomalies have been detected, and all DSSs are having difficulty with the new monitor printer device and its interface with the DIS. Cognizant engineers are working these problems; an update to DOI-5046 is planned for release in September 1973.

3. **Tracking data handling subsystem (TDH).** Previously reported TDH hardware problems involving the sample-rate selector have been resolved. All stations have now received, installed, and tested this unit. Implementation of the planetary ranging assembly hardware continues on schedule. Delivery of the first unit from the contractor is expected in mid-September 1973. After integration with associated software and testing at JPL, the first unit will be installed at DSS 12. Installation at DSS 12 rather than DSS 14 is a significant change in the planetary ranging implementation plan. This action was taken to assure the availability of ranging data for MVM⁷³ during November-December 1973 when the Pioneer Project has priority use of the 64-meter subnetwork.

The planetary ranging software still appears to be on a critically tight schedule. However, the developers assure that an interim version will be available for initial installation and test purposes in mid-September 1973.

4. S/X-band equipment. The Block IV receiver/exciter implementation required for the DSS 14 S/X-band research and development experiment is essentially on schedule. Installation at DSS 14 is scheduled for October 8, 1973, versus the originally planned October 1, 1973, date. Final receiver hardware components are now being received and assembled at JPL for subsystem testing. In early August, the exciter portion was installed temporarily at CTA 21 and successfully employed to demonstrate command capabilities and compatibility with the spacecraft. The coherent reference generator was installed and successfully tested at DSS 14. The improved S-band maser for this experiment completed assembly and laboratory testing at JPL as planned. This maser is fitted with the experimental superconducting magnet structure and incorporates improved design. Measurements show a reduction in temperature from 4.2 kelvins to about 2.2 kelvins. The zero-delay calibration equipment is ready for final system-level checkout during tests planned for September-October 1973 at DSS 14.

IV. Test and Training Activities

July and August 1973 was a period of intensive DSN testing for MVM'73. Accelerated testing with the DSSs resulted in the recovery of most time lost due to late hardware and software deliveries. CTA 21 was used to conduct DSN/spacecraft compatibility verification tests during the spacecraft thermal test activity at JPL. CTA 21 also supported Mission Operations System/spacecraft compatibility tests during this period. These tests have demonstrated compatibility with the MVM'73 spacecraft and DSN operational readiness to support Mission Operations System launch and encounter training exercises which were initiated in early August 1973. Exceptions are noted in the following discussion.

A. Ground Data System Tests

It was reported in the previous article that the DSN was approaching a state of readiness to support the Ground Data System (GDS) demonstration test on July 2, 1973. This proved to be true, in that DSSs 42, 62, and 14 successfully supported the 24-h test as scheduled. DSS original data record retransmission could not, however, be demonstrated due to the nonavailability of this capability in the current TCD software. Revision A of the software will contain this function, requiring additional testing in September 1973.

GDS tests were conducted with DSSs 43 and 71. A special test was run to verify end-to-end performance of

117-kilobits/s video from DSS 14 to JPL via the 230 kilobits/s wideband circuit. Follow-up GDS tests have been conducted to clear discrepancies noted in early tests. GDS tests for DSS 63 are scheduled for September 1973. Planning has been initiated for testing of DSS 14's S/X-band capabilities in October 1973.

B. DSN Tests and Training

On-site training for DSSs supporting MVM'73 continued during July and August. This consisted of reviewing video tapes, review of MVM'73 documentation, and participation in DSS internal simulations. DSN system performance tests were completed at each DSS. DSN Operational Verification Tests (OVT) were initiated and completed such that each operations crew at each DSS participated in at least two OVTs. A total of twenty-nine 8-h OVTs were conducted at the MVM'73 supporting DSSs, with DSS 63 being an exception. At DSS 63, on-site training and system performance tests were initiated in early August; OVTs are scheduled to follow. Successful DSN performance demonstration tests (PDT) were conducted at each DSS, except DSSs 63 and 71. The PDT for DSS 71 must be repeated in early September 1973 to complete checkout of the wideband subsystem. The PDT for DSS 63 is scheduled for late September 1973. All DSSs, except DSS 63, have participated in Mission Operations System launch and encounter exercises conducted in August. To date, this testing at DSSs 43 and 63 has excluded wideband data due to the nonavailability of wideband data terminals prior to late August. Due to cost considerations, wideband data circuits will not be available for long-loop tests with these stations until late September 1973. DSN testing and training will continue during the next 2 months as necessary to achieve the required state of readiness for MVM'73 launch and mission support.

C. DSN/Spacecraft Compatibility Tests

The spacecraft compatibility tests were performed between 18 and 29 July 1973 and on August 3, 1973 via an RF link between CTA 21 and the flight spacecraft in the JPL thermal-vacuum facility. Tests totaling approximately 44 hours were conducted during four separate test periods: 1-sun, 2-suns, 4.8-suns, and ambient temperature. Only minor incompatibility problems were observed in command, telemetry, and tracking; however, discrete ranging test results indicated a possible significant interference problem. Telemetry channel signal-to-noise ratios showed an increase rather than a decrease. This problem requires further investigation to determine the extent of telemetry degradation. Block IV exciter (S-band) command capa-

bility was established during the tests on August 3. The S/X-band receiver tests were not accomplished as planned, due to nonavailability of Block IV receiver equipment.

Upon acquiring the spacecraft signal for the first time, it was noted that the downlink signal level was unstable, indicating an RF leakage problem. Through the use of various test configurations, the leakage was isolated to the spacecraft. By adding a 20-dB pad at the Compatibility

Test Area (CTA 21) antenna at JPL, the multi-path was attenuated to the extent that it did not affect testing.

Compatibility verification tests are now in progress at Cape Kennedy between the Compatibility Test Station (DSS 71) and the spacecraft. Specific attention is being given in these tests to open areas resulting from the July test at JPL. The detailed test report provides a full description of these tests and results.